Nirma University
Institute of Technology
Department of Electrical Engineering
2EE405 Power Electronic Converters and Applications Question bank

Active Learning:

Simulate following converter with loading condiction in PSIM / MATLAB

(i) Buck converter

(ii) Boost converter

(iii) Buck-boost conveter

(iv) Push pull converter

(v) Fly back converter

(vi) Forward converter

(vii) Half bridge and full bridge DC-DC converter

(viii) Two level PWM based inverter

1. In the _____ type of chopper, two stage conversions takes place.
a) AC-DC
b) AC link
c) DC link
d) None of the mentioned

2. A chopper may be thought as a
a) Inverter with DC input
b) DC equivalent of an AC transformer
c) Diode rectifier
d) DC equivalent of an induction motor

3 Which device can be used in a chopper circuit?
a) BJT
b) MOSFET
c) GTO
d) All of the mentioned

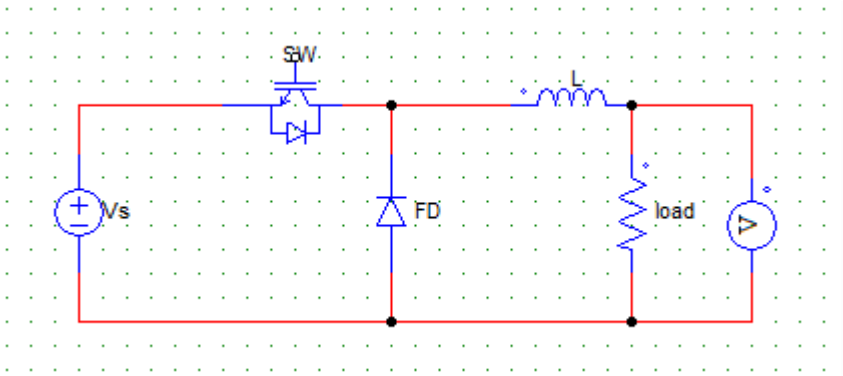
4 What is the duty cycle of a chopper ?
a) Ton/Toff
b) Ton/T
c) T/Ton
d) Toff x Ton

5 The values of duty cycle (α) lies between
a) $0<\alpha<1$
b) $0>\alpha>-1$
c) $0<=\alpha<=1$
d) $1<\alpha<100$

6 Find the output voltage expression for a step down chopper with Vs as the input voltage and α as the duty cycle.

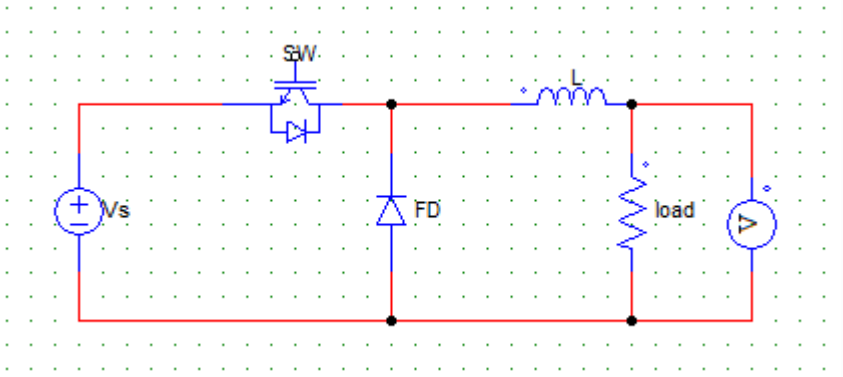
a) Vo = Vs/α
b) Vo = Vs x α
c) Vo = Vs^2/α
d) Vo = 2Vs/απ

7 The below given figure is that of a _____ (IGBT is used as a chopper switch)



a) step-up/step-down chopper
b) step-down chopper
c) step-up chopper
d) none of the mentioned

8 In the below given circuit, when switch (SW) is on

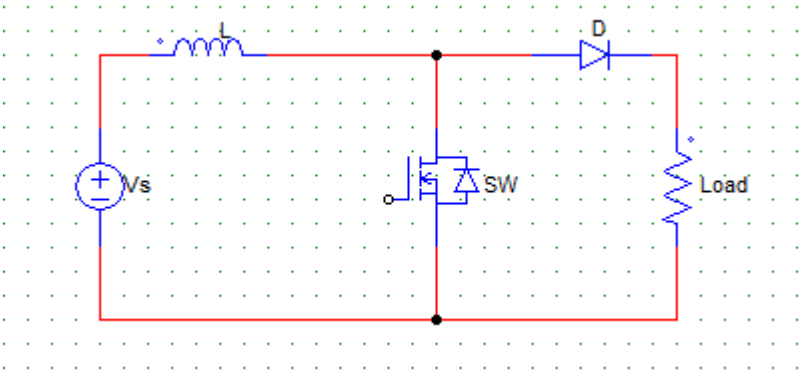


a) voltage is non-zero and current is rising
b) voltage is non-zero and current is decaying
c) voltage is zero and current is rising
d) voltage is zero and current is decaying

9 In a step down chopper, if Vs = 100 V and the chopper is operated at a duty cycle of 75 %. Find the output voltage.

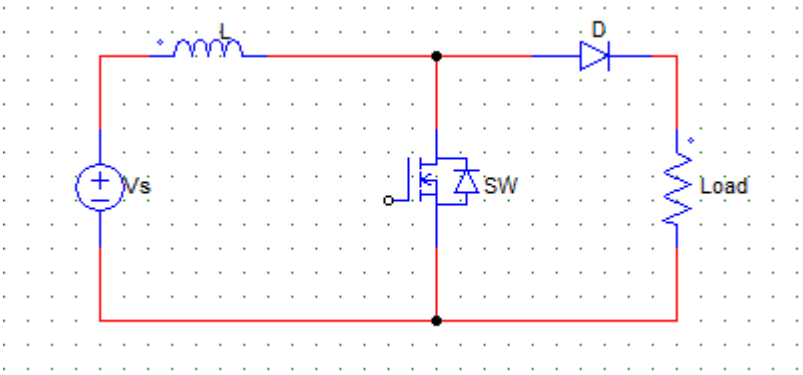
a) 100 V
b) 75 V
c) 25 V
d) none of the mentioned

10 If Vo is the output voltage and Vs is the input DC voltage, then for the below given circuit.



a) Vo = Vs
b) Vo < Vs
c) Vo > Vs
d) Insufficient information

11 What is the voltage across the load when the SW is first closed and then opened?



a) Vs
b) duty cycle x Vs
c) Vs + L (di/dt)
d) zero

12 Find the output voltage for a step-up chopper when it is operated at a duty cycle of 50 % and Vs = 240 V.
a) 240 V
b) 480 V
c) 560 V
d) 120 V

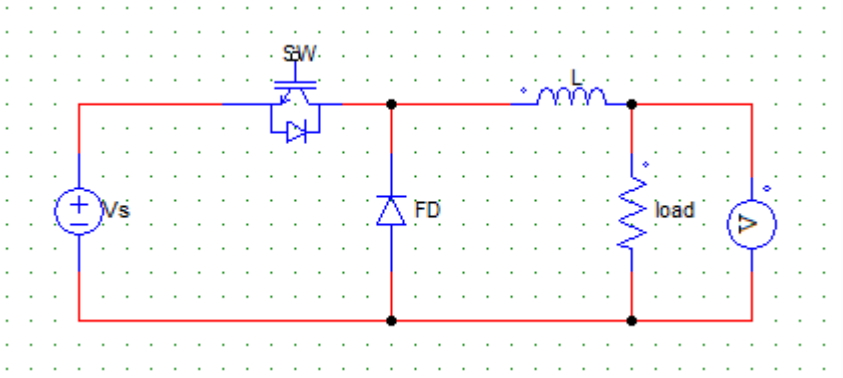
13 If a step up chopper's switch is always kept off then (ideally)
a) Vo = 0
b) Vo = ∞
c) Vo = Vs
d) Vo > Vs

14 A step down chopper is operated at 240V at duty cycle of 75%. Find the value of RMS switch (IGBT/MOSFET) current. Take R = 10 Ω.
a) 2.07 A
b) 200 mA
c) 1.58 A
d) 2.4 A

15 A step-up chopper has input voltage of 220 V and output voltage of 660 V. If the conducting time of the IGBT based chopper is 100 µs, compute Toff width of the output voltage pulse.

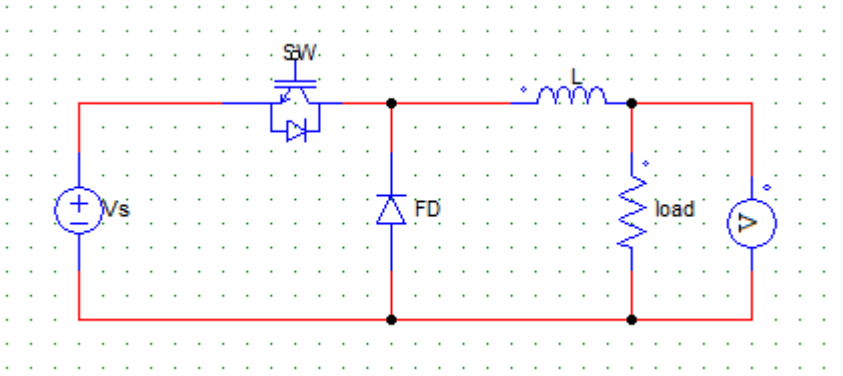
a) 100 µs
b) 150 µs
c) 50 µs
d) Insufficient data

16 For a step-down chopper shown in the figure below, dc source voltage = 230 V and the voltage drop across the chopper = 2 V. Find the value of average output voltage for a duty cycle of 0.4.



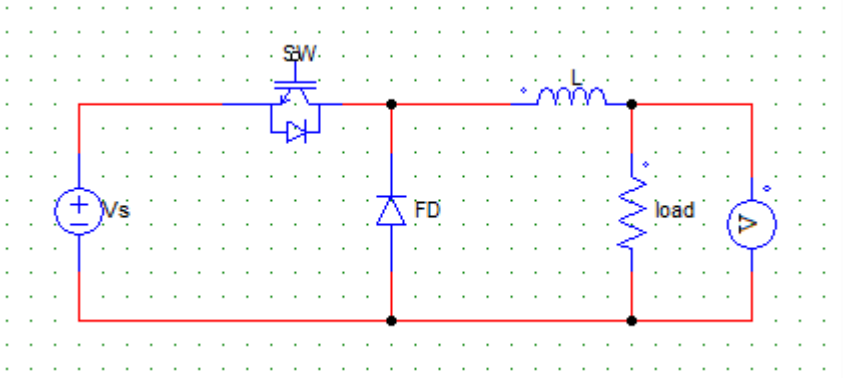
a) 230 V
b) 92 V
c) 90 V
d) 91.2 V

17 For the step-down chopper shown in the figure below, dc source voltage = 230 V and the voltage drop across the chopper = 2 V. Find the value of rms output voltage for a duty cycle of 0.4.



a) 91.2 V
b) 230 V
c) 144.2 V
d) 145 V

18 For the step-down chopper shown in the figure below, dc source voltage = 230 V. Find the power delivered to the load of R = 10 Ω. Duty cycle = 40 %. Take voltage drop at the switch to be 2 V.



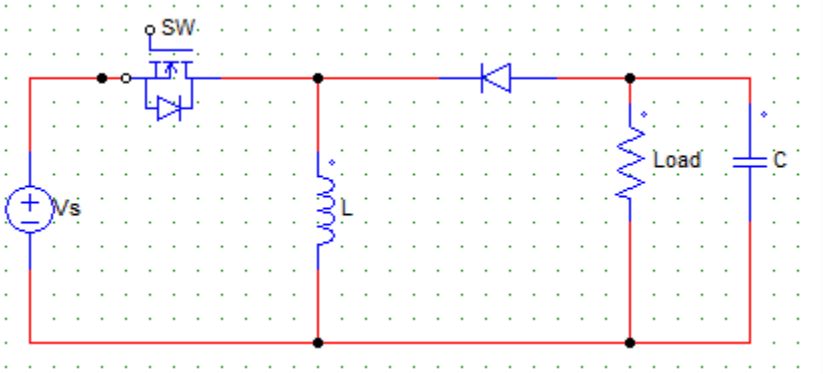
a) 1 kW
b) 2.08 kW
c) 569 W
d) 207 W

19 For a step-up/step-down chopper, if the duty cycle > 0.5 then
a) Vo = Vs
b) Vo < Vs
c) Vo > Vs
d) None of the mentioned

20 A step down chopper has Vs = 230 V and R = 10 Ω. For a duty cycle of 0.4, the power taken by the chopper is 2097 Watts. Find the chopper efficiency. Take the voltage drop across the chopper switch as 2 V.
a) 98 %
b) 89.96 %
c) 99.14 %
d) 96.54 %

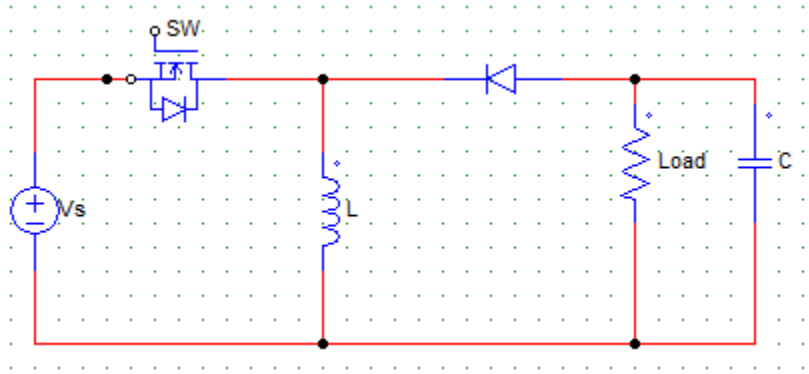
21 A step down chopper has input dc voltage of 220 V and R = 10 Ω in series with L = 65 mH. If the load current varies linearly between 11 A and 17 A, then find the duty cycle α.
a) 1
b) 0.4
c) 0.6
d) 0.7

22 In the figure shown below, the capacitor C is used to



a) maintain the load voltage constant
b) protect the load
c) protect the chopper switch (SW)
d) maintain the load current constant

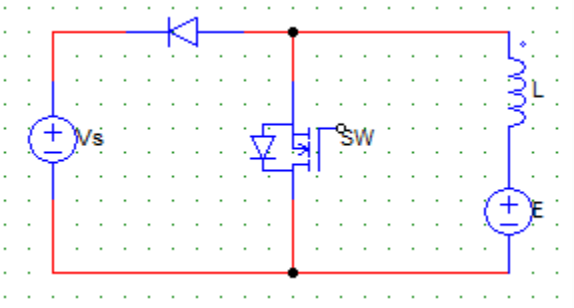
23 In the below shown step-up/step-down chopper circuit, when the switch (SW) is on



a) current through inductor rises and the load voltage is zero
b) current through inductor rises and the load voltage is Vs
c) current through inductor decays and the load voltage is zero
d) current through inductor decays and the load voltage is Vs

24 For a step-up/step-down chopper, if current increases from I_1 to I_2 linearly during T_{on}, then find the energy stored in the inductor during T_{on}
a) zero
b) Vs x $(I_1 + I_2)$
c) Vs x $[(I_1 + I_2)/2]$ x T_{on}
d) Vs x $[(I_1 + I_2)/2]$ x T

25 For the type-B chopper shown below

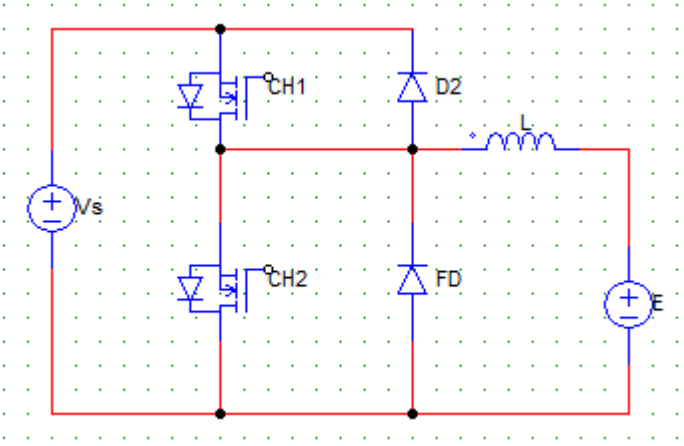


a) during T_{on}, Vo = 0 and L stores energy
b) during T_{on}, Vo is not 0 and L stores energy
c) during T_{on}, Vo = 0 and L releases energy
d) during T_{on}, Vo is not 0 and L releases energy

26 The type-C chopper or two quadrant type-A chopper has
a) type-A and type-B choppers in series
b) type-A and type-B choppers in parallel
c) two type-A choppers in series
d) two type-A choppers in parallel

27 In case of a constant frequency system, Ton = (1/4)T. If the chopping frequency 2 kHz, find the value of Toff.
a) (1/8) ms
b) (3/8) ms
c) (1/8) µs
d) (3/8) µs

28 In the below given type C chopper circuit, _____ and _____ together operate like type A chopper.

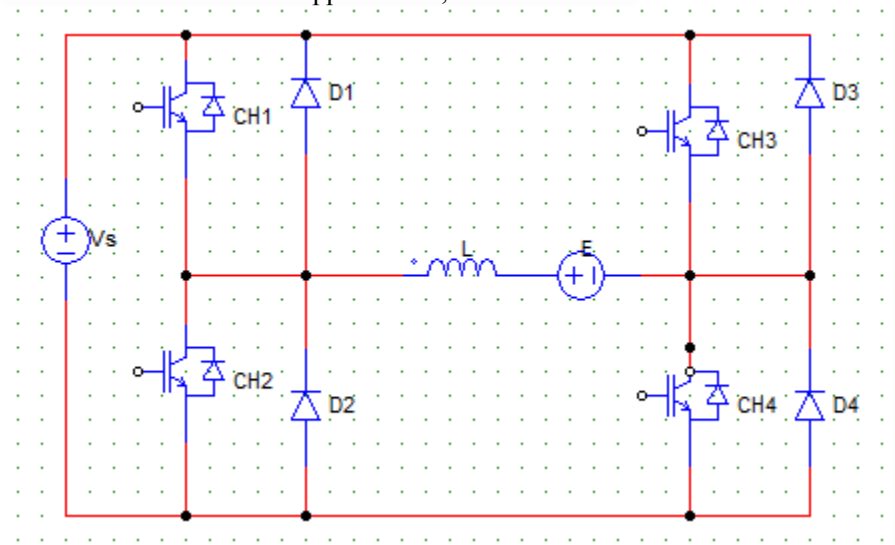


a) CH1, FD
b) CH2, FD
c) CH1, D2
d) CH2, D2

29 For a type D chopper, the average value of output voltage will be positive when
a) $T_{on} = T_{off}$
b) $T_{on} < T_{off}$
c) $T_{off} = 0$
d) $T_{on} > T_{off}$

30 Find the average output voltage for a type D chopper if it is given a dc supply of 220 V. Chopper frequency is 2 kHz and both the chopper switches are operated for 0.3 ms.
a) 220 V
b) 108 V
c) 98 V
d) 44 V

31 In the below shown chopper circuit, when CH3 is on



a) both load voltage and current are zero
b) both load voltage and current are positive
c) both load voltage and current are negative
d) none of the mentioned

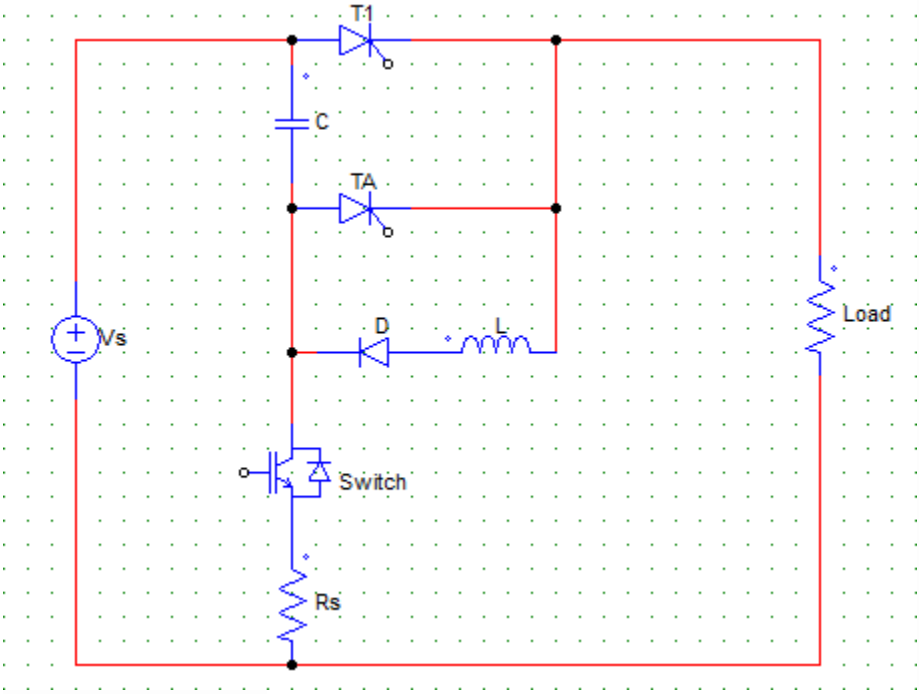
32 Find the expression for the ripple factor in terms of duty cycle α for a type A step down chopper
a) $\sqrt{(1-\alpha/\alpha)}$

b) $\alpha^2/2$
c) $\sqrt{\alpha}/2$
d) $\sqrt{(1-\alpha)}$

33 A type A step down chopper has Vs = 220 V and is connected to RLE load. With R = 1 Ω, E = 24 V and L large enough to maintain continuous conduction. Find the average value of load current for a duty cycle of 30 %.
a) 100 A
b) 22 A
c) 42 A
d) 16.5 A

34 A step down chopper has Vs = 220 V and is connected to RLE load. With R = 1 Ω, E = 24 V and L = 5 mH. The chopping period is 2000 µs and the on-period is 600 µs. Find the value of minimum steady state output current.
a) 33 A
b) 42 A
c) 0 A
d) 51 A

35 In the below given circuit, when the main thyristor T1 is triggered after charging the capacitor, the commutation current flows through the path



a) Vs – T1 – Load – Vs
b) S – C – T1 – Load – S
c) C – T1 – L – D – C
d) C – T1 – TA – C

36 What is the expression for the value of the capacitor in the voltage commutation circuit? Let tc be the circuit turn off time and Io be the constant load current.
a) Io x (dv/dt)
b) Vs/Io
c) (tc x Io)/Vs
d) none of the mentioned

37 A voltage commutated chopper feeds power to an electric car (battery-powered). The battery voltage is 60 V. The SCR turn-off time is 20 μs. Calculate the value of capacitor (C) required for the commutating circuit.
a) 400 μF
b) 40 nF
c) 40 μF
d) 0.4 Mf

38 A voltage commutated chopper feeds power to an electric car (battery-powered). The battery voltage is 60 V. Starting current is 60 A and the SCR turn-off time is 20 μs. Calculate the value of inductance (L) required for the commutating circuit.
a) 400 μH
b) 40 nH
c) 40 μH
d) 0.4 mH

39 A current commutated chopper is fed from a source of 230 V. Its commutating components are L = 20 μH and C = 50 μF. Find the value of peak commutating current.
a) 233 A
b) 59 A
c) 363 A
d) 198 A

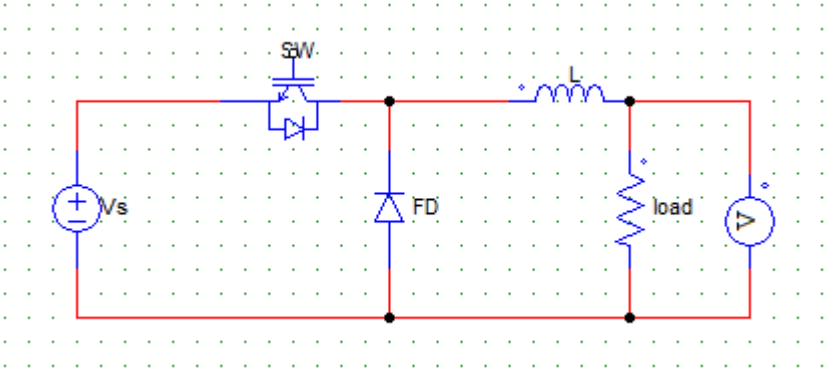
40 A voltage commutated chopper has the following parameters:
Vs = 220 V. Commutation circuit: L = 20 μH and C = 50 μF.
Find the effective on period for a constant load current of 80 A and Ton = 800 μsecs.
a) 1.075 μs
b) 10.75 ms
c) 1075 μs
d) 1.075 sec

41 A voltage commutated chopper has the following parameters:
Vs = 220 V. Commutation circuit: L = 20 μH and C = 50 μF.
Find the turn-off time for the main SCR with a constant load current of 80 A and Ton = 800 μsecs.
a) 137.5 μs
b) 1075 μs
c) 49.67 μs
d) 200 μs

42 What is the expression for design of commutation capacitance in case of a load commutated chopper circuit?
a) (I x Ton)/Vs
b) Cannot be determined
c) (I x Ton)/2Vs
d) (I x T)/Vs

43 The speed of a separately excited dc motor is controlled below base speed by using a type-A SCR based chopper. The supply voltage is 220 V dc and the armature resistance is 0.5 Ω. Calculate the minimum value of firing angle if the motor drives a constant torque load requiring an average armature current of 30 A.
a) 1/2
b) 3/44
c) 59/46
d) 7/12

44 For the step down chopper shown in the figure below, Vs = 100 V and the duty cycle of the switch is 0.8. The load is sufficiently inductive so that the load current is ripple free. The average current through the diode (D) under steady state is



a) 2 A
b) 1.6 A
c) 8 A
d) 6.4 A

45 A chopper circuit is fed from an input voltage of 20 V delivers a power of 16 watts. If the chopper efficiency is 80 %, then find the value of input current.
a) 0.64 A
b) 1 A
c) 0.8 A
d) 1.25 A

46 Line-commutated inverters have
a) AC on the supply side and DC on the load side
b) AC on both supply and load side
c) DC on both supply and load side
d) DC on the supply side and AC on the load side

47 In a VSI (Voltage source inverter)
a) the internal impedance of the DC source is negligible
b) the internal impedance of the DC source is very very high
c) the internal impedance of the AC source is negligible
d) the IGBTs are fired at 0 degrees

48 Single phase half bridge inverters requires
a) two wire ac supply
b) two wire dc supply
c) three wire ac supply
d) three wire dc supply

49 The output current wave of a single-phase full bridge inverter on RL load is
a) a sine wave
b) a square wave
c) a triangular wave
d) constant dc

50 The fundamental component of output voltage for a half wave bridge inverter is given by
a) $(4Vs/\pi)\ \sin\omega t$
b) $(2Vs/\pi)\ \sin\omega t$
c) $(Vs/2\pi)\ \sin\omega t$
d) (Vs)

51 The fundamental component of output voltage for a full wave bridge inverter is given by
a) $(2Vs/\pi)\ \sin\omega t$
b) $(4Vs/\pi)\ \sin\omega t$
c) $(Vs/2\pi)\ \sin\omega t$
d) (Vs)

52 A single phase half bridge inverter has a dc voltage source Vs/2 = 115 V. Find the rms value of the fundamental component of output voltage.
a) 510 V
b) 103.5 V
c) 120 V
d) 96 V

53 A single phase half bridge inverter has load R = 2 Ω and a dc voltage source Vs/2 = 115 V. Find the power delivered to the load due to the fundamental component.
a) 536 kW
b) 53.61 kW
c) 5.361 kW
d) 536 W

54 A single phase full bridge inverter has load R = 2 Ω, and dc voltage source Vs = 230 V. Find the rms value of the fundamental load current.
a) 96 A
b) 0 A
c) 103 A
d) none of the mentioned

55 A certain full bridge type inverter circuit has its rms value of fundamental load current component given by W. The fundamental frequency component of the load current would be given by
a) $W \sin \omega t$
b) $(W/\sqrt{2}) \sin \omega t$
c) $\sqrt{2}\ W \sin \omega t$
d) $\sin \omega t$

56 In a half wave bridge inverter circuit, the power delivered to the load by each source is given by
a) Vs x Is
b) (Vs x Is)/2
c) 2(Vs x Is)
d) None of the mentioned

57 A single phase full bridge inverter circuit, has load R = 2 Ω and dc source Vs = 230 V. Find the value of power delivered to the load in watts only due to the fundamental component of the load current.
a) 5361.5 W
b) 2142.5 W
c) 21424.5 W
d) 214.2 W

58 A single phase full bridge inverter has RLC load. The dc input voltage is 230 V and the output frequency is 50 Hz. Find the expression for the load voltage up to the fifth harmonic.
a) 292 sin 314t + 97.62 sin 314t + 58.57 sin 318t + 28.31 sin 318t + 3.686 sin 318t
b) 292 sin 314t + 97.62 sin (3 x 314t) + 58.57 sin (5 x 318t)
c) 292 sin 314t + 97.62 sin (2 x 314t) + 58.57 sin (3 x 318t) + 28.31 sin (4 x 318t) + 3.686 sin (5 x 318t)
d) 292 sin 512t + 25.62 sin 249t + 6.74 sin 508t

59 A single phase full bridge inverter has RLC load with R = 4 Ω, L = 35 mH and C = 155 μF. The dc input voltage is 230 V and the output frequency is 50 Hz. Find the rms value of the fundamental load current.
a) 28.31 A
b) 20.02 A
c) 16.69 A
d) 26.90 A

60 A single phase full bridge inverter has RLC load with R = 4 Ω, Xl = 11 Ω and Xc = 20.54 Ω. The dc input voltage is 230 V. Find the value of fundamental load power.
a) 1633 W
b) 1603 W
c) 1576 W
d) none of the mentioned

61 A single phase full bridge inverter has RLC load with R = 4 Ω, L = 35 mH and C = 155 μF. The dc input voltage is 230 V and the output frequency is 50 Hz. Find the angle by which the third harmonic current will lead/lag the third harmonic output voltage.
a) 67.25°
b) 96.4°
c) 49.87°
d) 81.3°

62 Let Vs be the amplitude of the output voltage and P be the output power for a single-phase half bridge inverter. Then the corresponding values for a full bridge inverter would be
a) 2Vs, 4P
b) 2Vs, 2P
c) Vs, P
d) 2Vs, P

63 The harmonic factor of nth harmonic is given by
a) V_n
b) V_1/V_n
c) V_n/V_1
d) None of the mentioned

64 _____ is the measure of the contribution of any individual harmonic to the inverter output voltage.
a) THD
b) Distortion Factor
c) Harmonic Factor
d) TUF

65 The Total Harmonic Distortion (THD) is the ratio of
a) rms value of all the harmonic components to the rms value of the fundamental component
b) average value of all the harmonic components to the rms value of the fundamental component
c) rms value of all the third harmonic component to the rms value of the fundamental component
d) rms value of all the fundamental component to the rms value of all the harmonic components

66 If V_r is the rms value of the inverter output voltage and V_1 is the rms value of the fundamental component, then the total harmonic distortion (THD) is given by
a) V_r/V_1
b) $(V_r + V_{1r}$
c) $[(V_r/V_1)^2 - 1]^{1/2}$
d) $[(V_r/V_1)^{1/2} + 1]^2$

67 Find the distortion factor (μ), for a single phase half wave bridge inverter with dc source Vs = 1 kV.
a) 0.87
b) 1
c) 0.9
d) 0.7

68 A single phase inverter gives rms value of output voltage as 115 V and the fundamental output voltage of as 103.5 V. Find the THD (Total Harmonic Distortion).
a) 0.4 %
b) 40.8 %
c) 48.3 %
d) 4.83 %

69 What would be the harmonic factor of lowest order harmonic in case of a half wave bridge inverter?
a) 1/1
b) 1/3
c) 1/2
d) Insufficient data

70 A single phase full bridge inverter using transistors and diodes is feeding a R load of 3 Ω with the dc input voltage of 60 V. Find the rms output voltage and the peak reverse blocking voltage of each transistor.
a) 30 V, 60 V
b) 30 V, 30 V
c) 60 V, 60 V
d) 60 V, 30 V

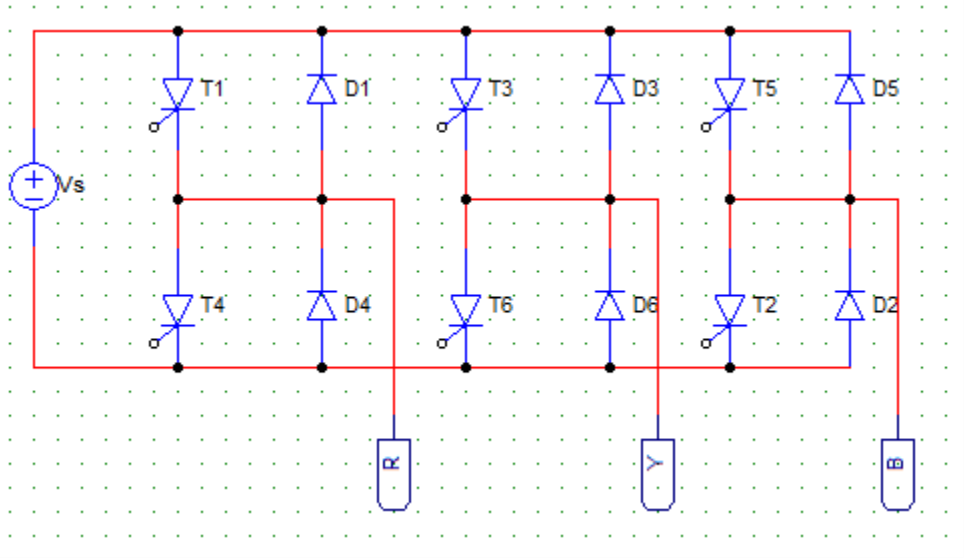
71 Determine the distortion factor (μ) for a full bridge inverter with supply Vs = 60 V.
a) 0.8
b) 0.7
c) 0.9
d) 1

72 The McMurray-Bedford half-bridge inverter requires
a) 4 SCRs, 2 diodes, 2 capacitors and 2 inductors
b) 4 SCRs, 4 diodes, 2 capacitors and 2 inductors
c) 2 SCRs, 4 diodes, 2 capacitors and 1 inductor
d) 2 SCRs, 2 diodes, 2 capacitors and 2 inductors

73 In the three-phase bridge inverter, each step consists of
a) 30°
b) 60°
c) 90°
d) will depend on the value of the firing angle

74 In the 180° mode VSI, _____ devices conduct at a time.
a) 5
b) 2
c) 3
d) 4

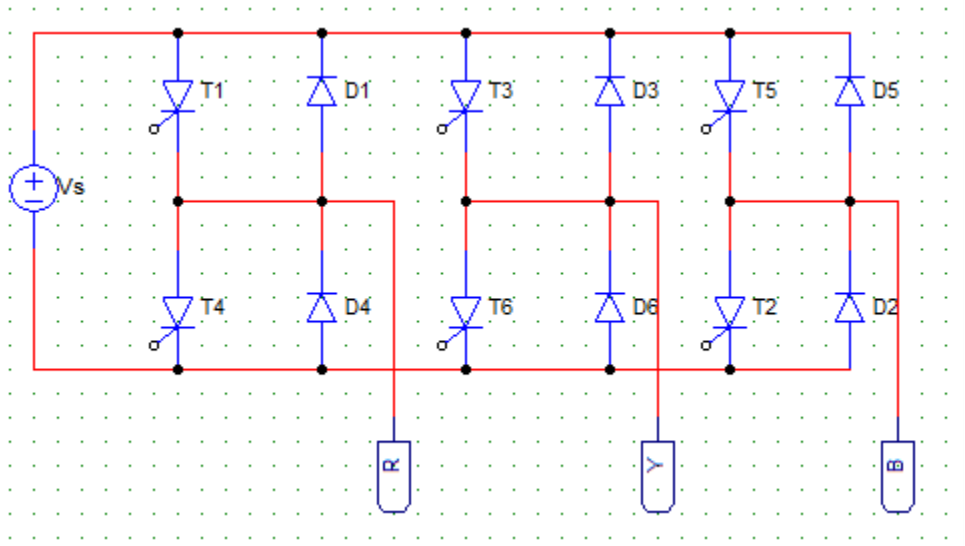
75 In the figure given below, for 180° mode of operation if T1 is fired at 0°. Then SCRs T3 and T5 should be fired at _____ and _____ respectively.



a) 180°, 360°
b) 90°, 180°
c) 120°, 240°
d) none of the mentioned

76 What is the peak value of phase voltage in case of 3-phase VSI with 180° mode. The supply side consists of a constant dc voltage source of Vs.
a) Vs
b) 3Vs/2
c) 2Vs/3
d) 3Vs

77 What are the phase voltages when T6, T1 and T2 are conducting? Consider a star connected R load.



a) $V_{YN} = V_{BN} = Vs/3$, $V_{RN} = 0$
b) $V_{YN} = V_{RN} = – Vs/3$, $V_{BN} = 2Vs/3$
c) $V_{RN} = V_{BN} = – Vs/3$, $V_{YN} = 2Vs/3$
d) $V_{YN} = V_{BN} = – Vs/3$, $V_{RN} = 2Vs/3$

78 The 120° mode of operation of a three phase bridge inverter requires _____ number of steps.
a) 2
b) 4
c) 6
d) 8

79 Safe commutation can be achieved in case of the _____ operating mode.
a) 180°
b) 120°
c) 360°
d) none of the mentioned

80 The peak value of the line voltage in case of 120° mode of operation of a three-phase bridge inverter is
a) Vs/2
b) 3Vs/2
c) Vs/√2
d) Vs

81 In case of a single-pulse width modulation with the pulse width = 2d, to eliminate the 5th harmonic from the output voltage waveform, the value of the pulse width (2d) must be equal to
a) 72°
b) 86°
c) 91°
d) 5°

82 In the multiple-pulse width modulation method, the Fourier coefficient a_n is
a) (Vs/π) [cos(nπ/2) cos(nd)].
b) 0
c) (4Vs/nπ) [sin(nπ/2) sin(nd)].
d) (2Vs/nπ) [sin(nπ/2) sin(nd)].

83 The amplitude of the nth harmonic of the two-pulse MPM waveform is given by _____
Let d be the width of a single pulse and ɣ be the distance from 0 to the centre of the first pulse.
a) (8Vs/nπ) sin(nɣ) sin(nd/2)
b) (4Vs/nπ) sin(nɣ) sin(nd/2)
c) (8Vs/nπ) sin(nπ) sin(nd/2)
d) (8Vs/nπ) sin(nɣ/2) sin(nd/2)

84 In case of MPM with two pulses per half cycle of width = d each and ɣ as the distance between the first pulse and ωt=0, for eliminating the nth harmonic from the output voltage, which of the following condition must be satisfied?
a) d = 2π
b) d = π
c) d = n°
d) d = 2π/n

85 Find the peak value of the fundamental component of voltage with MPM with two pulses having pulse width = 36° and ɣ = 54°. The Fourier representation of the waveform is as follows.

$$\sum_{n=1,3,5}^{\infty} \frac{8Vs}{n\pi} \sin n\gamma \sin \frac{nd}{2} \sin n\omega t$$

a) 0.7484 x Vs
b) 1.414 x Vs
c) 0.637 x Vs
d) 2.54 x Vs

86 In case of sinusoidal pulse width modulation with MI < 1, if the number of pulses per half cycle (N) = 5, then
a) harmonics of order 5 and 7 become significant
b) harmonics of order 5 and 7 are eliminated
c) harmonics of order 9 and 11 become significant
d) harmonics of order 9 and 11 are eliminated

87 In case of sinusoidal pulse width modulation with MI < 1, if the number of pulses per half cycle (N) = 6, then
a) harmonics of order 7 and 9 become significant
b) harmonics of order 7 and 9 are eliminated
c) harmonics of order 11 and 13 become significant
d) harmonics of order 11 and 13 are eliminated

88 In single-phase modulation of PWM inverters, the pulse width is 120°. For an input voltage of 220 V dc, the rms value of output voltage is
a) 185 V
b) 254 V
c) 127 V
d) 179 V

89 In MPM the amplitudes of square wave and triangular wave are respectively 1 V and 2 V. For generating 5 pulses per half cycle, the pulse width should be _____
a) 36°
b) 24°
c) 12°
d) 18°

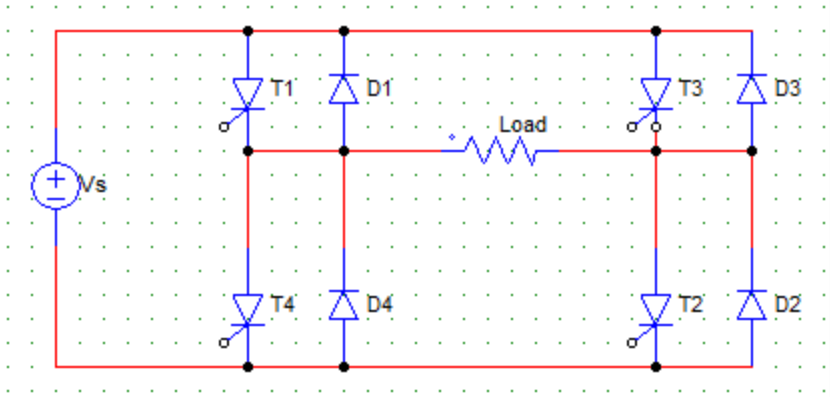
90 Calculate the pulse width in case of MPM, if the amplitudes of square wave and triangular wave are respectively 2 V and 3 V respectively. 16 pulses per cycle are generated.
a) 18°
b) 7.5°
c) 6.4°
d) 9°

91 In case of multiple pulse width modulation method, if the amplitudes of the reference wave and the carrier wave are made equal then, the pulse width =
a) ∞
b) 0
c) 100 °
d) none of the mentioned

92 In an inverter, if the fundamental output frequency is 45 Hz, then the frequency of the second lowest order harmonic will be
a) 45 Hz
b) 135 Hz
c) 225 Hz
d) 9 Hz

93 A single-phase bridge inverter has a square wave output voltage waveform, with odd harmonics present. What is the percentage of the fifth harmonic component to the fundamental component?
a) 50 %
b) 25 %
c) 20 %
d) 5 %

94 Find, the maximum rms value of the fundamental component of the output voltage for the below given single pulse width modulated circuit. Take Vs = 68 V.



a) 86.6 sin(d)
b) 64 sin(d)
c) 244 sin(d)
d) none of the mentioned

95 A single-phase bridge inverter, fed from a 230 V dc is connected to the load R = 10 Ω and L = 0.03 H. Determine the fundamental component of rms output current. Fundamental output frequency of the square wave output = 50 Hz.
a) 30 A
b) 15 A
c) 2.3 A
d) 20.7 A

96 The output voltage obtained by connecting two inverters through a transformer is a
a) square wave
b) sine wave
c) quasi-square wave
d) none of the mentioned

97 In case of stepped wave inverters,
a) both the transformers have 1:1 turns ratio
b) both the transformers have 1:2 turns ratio
c) both the transformers have different transformer ratio
d) none of the mentioned

98 In single-phase modulation of PWM inverters, the lowest harmonic can be eliminated if the pulse width is made equal to _____
a) 30°
b) 0°
c) 120°
d) 60°

99 In current source inverters
a) L filter is used after the CSI (load side)
b) L filter is used before the CSI (input side)
c) C filter is used after the CSI (load side)
d) C filter is used before the CSI (input side)

100 In a 3-phase VSI operating in square-wave mode, the output line voltage is free from
a) 3rd harmonic
b) 7th harmonic
c) 11th harmonic
d) 13th harmonic

Q1. For type-A chopper, dc source voltage = 230 V, load resistance R=10 Ω. Take a voltage drop of 2 V across the chopper when it is on. For a duty cycle of 0.4, calculate:
(i) Average and rms value of output voltages
(ii) Chopper efficiency

Q2. A voltage commutated chopper has following parameters:
V_s = 220 V , load circuit parameters= 0.5 Ω, 2 mH, 40 V and commutation circuit parameters: L= 20 μH and C= 50 μF. T_{on}=800 μSec and T=2000 μSec. For a constant load current of 80 A, compute the following
(i) Effective on period
(ii) Peak current through the main thyristor and auxiliary thyristor
(iii) Turn off time for T_1 and T_A
(iv) Total commutation interval
(v) Capacitor voltage 150 μSec after T_A is triggered.
(vi) Time needed to recharge the capacitor to voltage V_s

Q3. A single phase bridge inverter has a resistive load R=2.4 ohm and the DC input voltage of 48 V. determine a) RMS output voltage at fundamental frequency. b) Output power c)I_{avg} and I_m.

Q4. A single phase auto sequential CSI is fed from 220V DC source. The load is R=10 ohm. Thyristor have taken a factor of safety of 2. Determine the value of source inductance assuming a maximum current change of 0.5 in one cycle. Neglect all losses. Find also the values of commutating capacitors

Q5. A star connected load of 25 ohm/phase is fed from 600V dc through a three phase bridge inverter for both 180^o mode and 120^o mode. Compute:
a. RMS value of load current mode. Determine
b. RMS value of thyristor Current
c. Load power.

Q6. A single phase bridge inverter fed from 230V dc is connected to load R=20 ohm & L=0.06H. Determine power delivered to load in case inverter is operating at 50 Hz with (a) square wave output. (b) Quasi square wave output with on period of 0.5 (c) Two symmetrically spaced pulses per half cycle on period of 0.5 of cycle.

Q7. A 7.2V zener diode is used to maintain a constant voltage across the load. The load current varies from 12mA to 100mA.Calculate the value of the series resistance in order to maintain a voltage of 7.2 across the load. The input voltage is maintained at 12v and the minimum zener current is 10mA.Also determine power rating of zener diode.

Q8. A zener diode is rated at 10V over a range of diode current from 8to100mA. The supply voltage is 501V.calculate the resistance Rs to be connected in series with the power supply and zener diode to allow voltage regulation for load current from 0amp to maximum load current . Determine maximum load current and power rating of zener diode.

Q9. For a current commutated chopper, peak commutating current is twice the maximum possible load current. The source voltage is 230 V dc and main SCR turn off time is 30 μSec. For maximum current of 200 A, calculate:
(i) The voltage of the commutating inductor and capacitor
(ii) Maximum capacitor voltage
(iii) The Peak commutating current
(iv) Repeat the problem for peak commutating current is thrice the maximum possible load current. Compare the results obtained in both the cases.

Q10. A step down chopper is operated at 200V at duty cycle of 55%. Find the value of RMS switch (IGBT/MOSFET) current. Take R = 10 Ω.

Q11. A step-up chopper has input voltage of 330 V and output voltage of 990 V. If the conducting time of the IGBT based chopper is 100 μs, compute Toff width of the output voltage pulse.

Q12. A single-phase bridge inverter, fed from a 200 V dc is connected to the load R = 5 Ω and L = 0.06 H. Determine the fundamental component of rms output current. Fundamental output frequency of the square wave output = 50 Hz.

Q13. A single phase full bridge inverter using transistors and diodes is feeding a R load of 10 Ω with the dc input voltage of 100 V. Find the rms output voltage and the peak reverse blocking voltage of each transistor.

Q14. A single phase full bridge inverter has RLC load with R = 10 Ω, L = 30 mH and C = 250 μF. The dc input voltage is 230 V and the output frequency is 50 Hz. Find the angle by which the third harmonic current will lead/lag the third harmonic output voltage.

Q15. A chopper circuit is fed from an input voltage of 100 V delivers a power of 16 watts. If the chopper efficiency is 70%, 80% and 90% then find the value of input currents respective chopper efficiency.

Cognitive Level Learning:

Q1.Discuss the working of following chopper converters and draw the respective converter current and voltage waveforms.
(i) Step down chopper (ii) Step up chopper (iii) Step down and Step up chopper.

Q2. Classify the chopper circuits based on thyristor commutation and draw the respective circuit waveforms with its circuit operation.

Q3. Analyze following chopper converters
- (i) Two quadrant type-A or type-C chopper
- (ii) Two quadrant type-B or type-D chopper
- (iii) Type-E chopper

Q4. Find the maximum value of average current rating of thyristor in type-A chopper feeding RLE load. Assume load current is constant.

Q5. Illustrate in-phase operation and phase shifted operation in multiphase chopper with neat sketch.

Q6. Analyze the following isolated converters
- (i) Forward converter
- (ii) Flyback converter
- (iii) Push pull converter
- (iv) Half bridge and full bridge converter

Q7. Compare between 180^o mode inverter operation and 120^o inverter mode operation in three phase inverter.

Q8. Develop the Fourier series expression for the output voltage and output current obtained from single phase full bridge inverter.

Q9.Explain the various PWM technique used in Single phase inverters.

Q10. Explain various voltage control method in single phase inverter using various PWM techniques with necessary diagram and waveform.

Q11 Discuss the different techniques adopted to eliminate the harmonics generated by inverter circuits.

Q12. Explain how multi pulse used to control the output voltage of single phase inverter with necessary diagram

Q13. Illustrate modified McMurray half bridge inverters with appropriate voltage and current waveforms. Derive the expressions for the commutating components L and C.

Q14. Explain the working of 180 degree conduction mode operation of three phase inverter with star and delta connection load with a neat circuit diagram and waveforms

Q15. Illustrate the working of 120 degree conduction mode operation of three phase inverter with star and delta connection load with a neat circuit diagram and waveforms

Q16. Explain how the space vector modulation used to control the output voltage of three phase inverter with necessary diagram

Q17. Illustrate the following terms
(i) Modified sinusoidal PWM
(ii) Feedback operation in inverter
(iii) Harmonic distortion in inverter

Q18. Explain SMPS with block diagram.

Q19. Explain how zener diode may be used in stabilizing the output of regulated power supply.

Q20. Compare linear power supply with SMPS.

Q21. Explain the principle of operation of SMPS with the help of block diagram.

Q22. Describe the principle of operation of op amp voltage regulator?

Q23. Explain with a neat circuit diagram the operation of series regulator using op-amp as switching element.

Q24. Why IGBT is very popular nowadays?

Q25. List the applications of dc chopper?

Q26. What is meant by duty-cycle?

Q27. Name the types of control strategies in DC choppers and explain it with neat sketch.

Q28. List the limitation of PWM control in dc chopper?

Q29. What are the advantages of PWM techniques in chopper compared to frequency modulation technique?

Q30. Name the different types of chopper with respect to commutation process.

Q31. What is multiphase chopper?

Q32. Define inverter?

Q33. List the applications of an inverter?

Q34. Why thyristors are not preferred for inverters?

Q35. Give the advantages of CSI.

Q36. What is the main drawback of a single phase half bridge inverter?

Q37. Name the control strategies used in inverter.

Q38. Why diodes should be connected in antiparallel with the thyristors in inverter Circuits?

Q39. Discuss series inverter and parallel inverter.

Q40. What is the condition to be satisfied in the selection of L and C in a series inverter?

Q41. How the inverter circuit classified based on commutation circuitry?

Q42. Define McMurray inverter?

Q43. What are the effects of the harmonics present in inverter system?

Q44. List the expression for average output voltage for step down chopper, step up chopper and step down-step choppers.

Q45. What are the advantages and disadvantages of multi pulse width modulation?

Q46. Define load commutated inverter.

Q47. Compare VSI and CSI.

Q48. What is partial and full overlapping in a three phase auto sequential commutated inverter?

Q49. Summarize the reason why low power devices cannot be used in a CSI.

Q50. List the main features of CSI

Q51. What is the purpose of hysteresis modulation?

Q52. What are the applications of CSI?

Q53. Build the block diagram of the general power supply?

Q54. How to provide over current protection in a power supply?

Q55. How to protect power supply against applying reverse voltage?

Q56. What is load regulation and line regulation?

Q57. What are different factors that improve regulation in voltage regulators?

Q58. What is the purpose of regulator in power supply?

Q59. List the advantages of SMPS over linear power supply.

Q60. Classify the regulated power supplies.

Q61. Define harmonic factor.

Q62. Name the methods for reduction of harmonic content.

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Innovative Assignment:

Q1. Presenting a research papers on following converters/topics.

(i) Buck-boost converter

(ii) Two level pulse width modulation inverters

(iii) Control strategies in inverters

(iv) Speed control of DC motors by chopper

(v) Speed control of induction motors by inverter

Q2. Simulation of classical inverter topologies.

Q3. Design the following converters.

(i) Buck converter

(ii) Boost converter

(iii) Buck-boost converter

(iv) Voltage commutated chopper

(v) Current commutated chopper